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Surgery Illustrated – Surgical Atlas
Charleston pouch continent cutaneous urinary diversion

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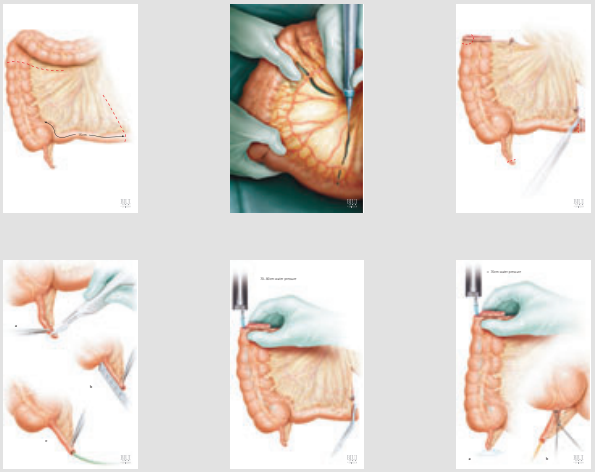
ILLUSTRATIONS by STEPHAN SPITZER, www.spitzer-illustration.com

INTRODUCTION

The use of the appendix as a catheterizable urinary stoma was popularized by Mitrofanoff in1980 [1]. In this procedure, the appendix was isolated with its blood supply and one end was tunnelled submucosally into the bladder while the other end was used to construct the cutaneous stoma. The appendix as well as the distal ileum has been modified using various techniques to create urinary continence mechanisms. In 1989, Bissada used the non-altered or minimally altered *insitu* appendix to construct the continence mechanism in a low-pressure urinary reservoir. The reservoir was constructed from detubularized colon and distal ileum. Bissada called the procedure the 'Charleston Pouch' [2–4].



HISTORY OF APPENDIX AS A CATHETERIZABLE STOMA

Verhoogen 1908
Colonic reservoir with unaltered appendix stoma

↓

Makkas 1910 and Taddei 1911
Colovesicoplasty with appendix for continence

↓

Lengeman 1912
Appendix passed obliquely through rectus

↓

Mitrofanoff 1980
Appendico-Vesicostomy

↓

Duckett 1982
Variations of Appendico-Vesicostomy

↓

Mainz Group 1991
Appendix in caecum

↓

Bissada 1991
In situ appendix (minimally or unaltered)

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OPERATIVE TECHNIQUE

Figure 1

Preoperative bowel preparation is prescribed at the surgeon's preference. After initial laparotomy and any necessary preliminary procedures, the bowel is examined. The caecum and ascending colon are mobilized to the hepatic flexure. The ascending colon, caecum and distal 15 cm of the ileum are isolated with their blood supply.

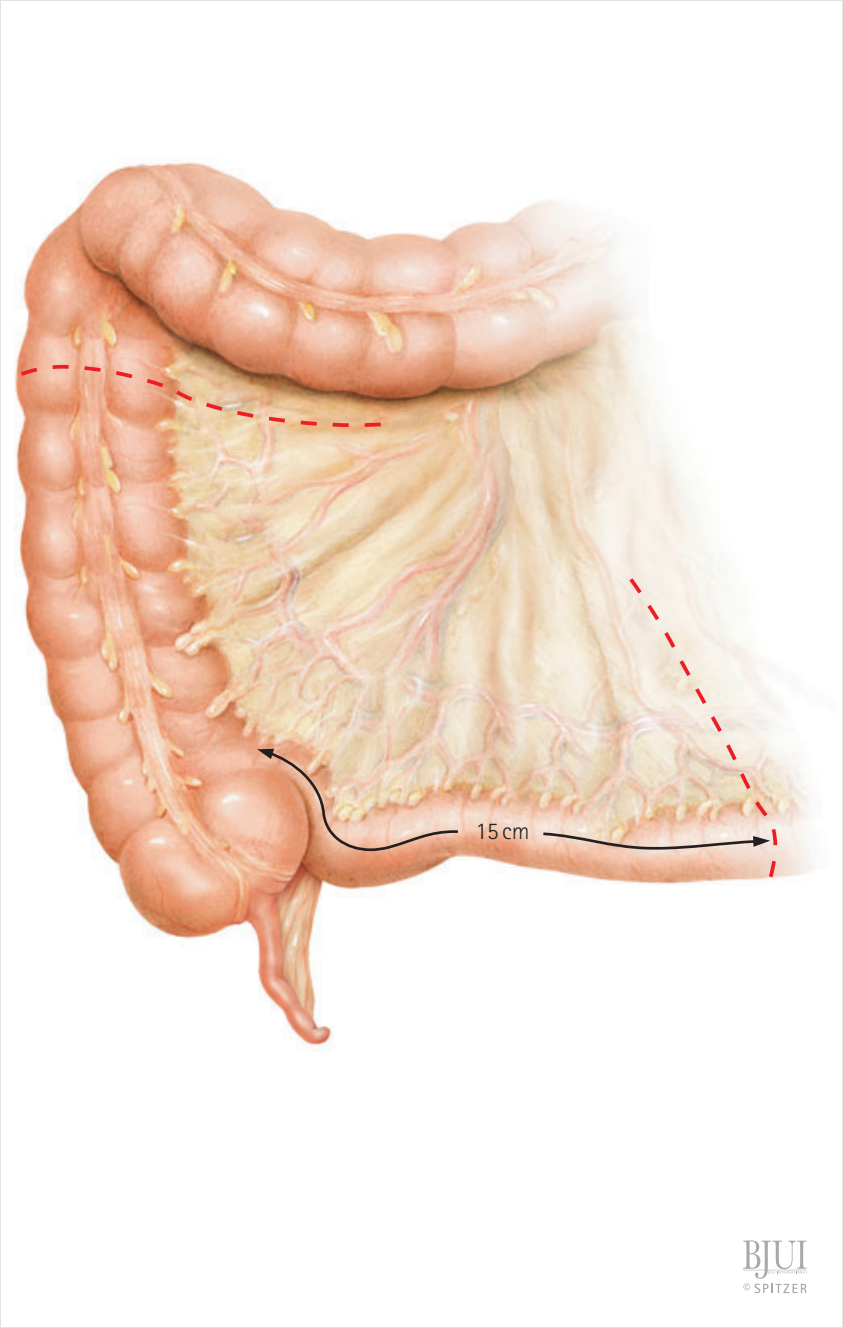

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Figure 2

Start by identifying and marking the site of dividing the ileum and ascending colon. The mesenteric blood vessels are visualized using transillumination. Mesenteric windows are made distal and proximal to the selected blood vessel(s). The selected segment of ileum, caecum, ascending colon and appendix is then isolated. We prefer to use a stapling device to isolate the bowel segment and to establish the bowel continuity by anastomosing the ileum to the colon close to the hepatic flexure with a side-to-side anastomosis.

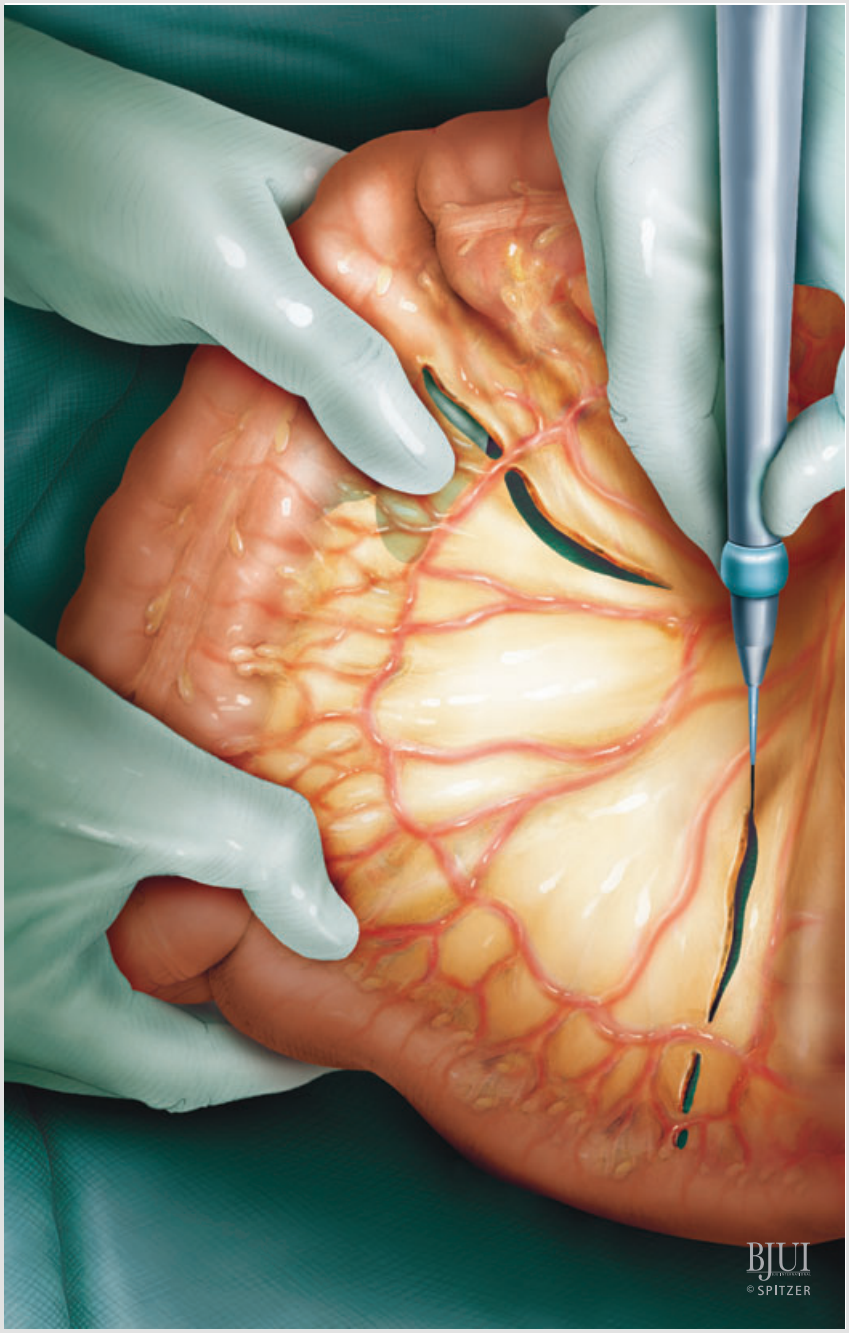

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Figure 3

Attention is then directed to the isolated bowel segment. The staple line on the ileum is excised. A corner of the staple line on the colon is also excised. We then start to irrigate the segment with antimicrobial solution.

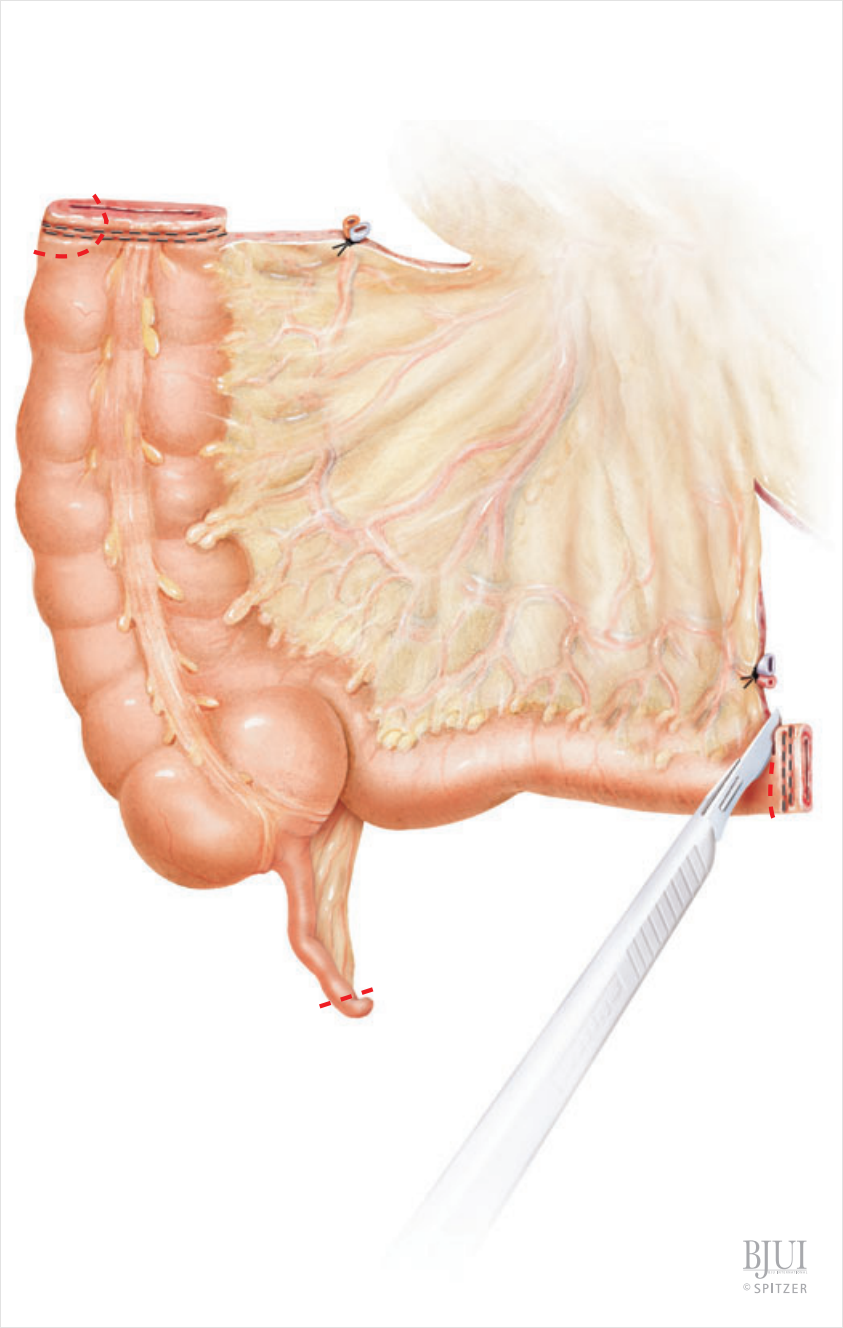

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Figure 4

The distal tip of the appendix is excised (a). The appendix is measured and calibrated (b). If the lumen is narrow, it is dilated gently with rubber catheters to 12 or 14 F (c). Occasionally, filliforms and followers are used if the lumen is too tight. At this point, appendicular leak-point pressure (LPP) is measured [5].

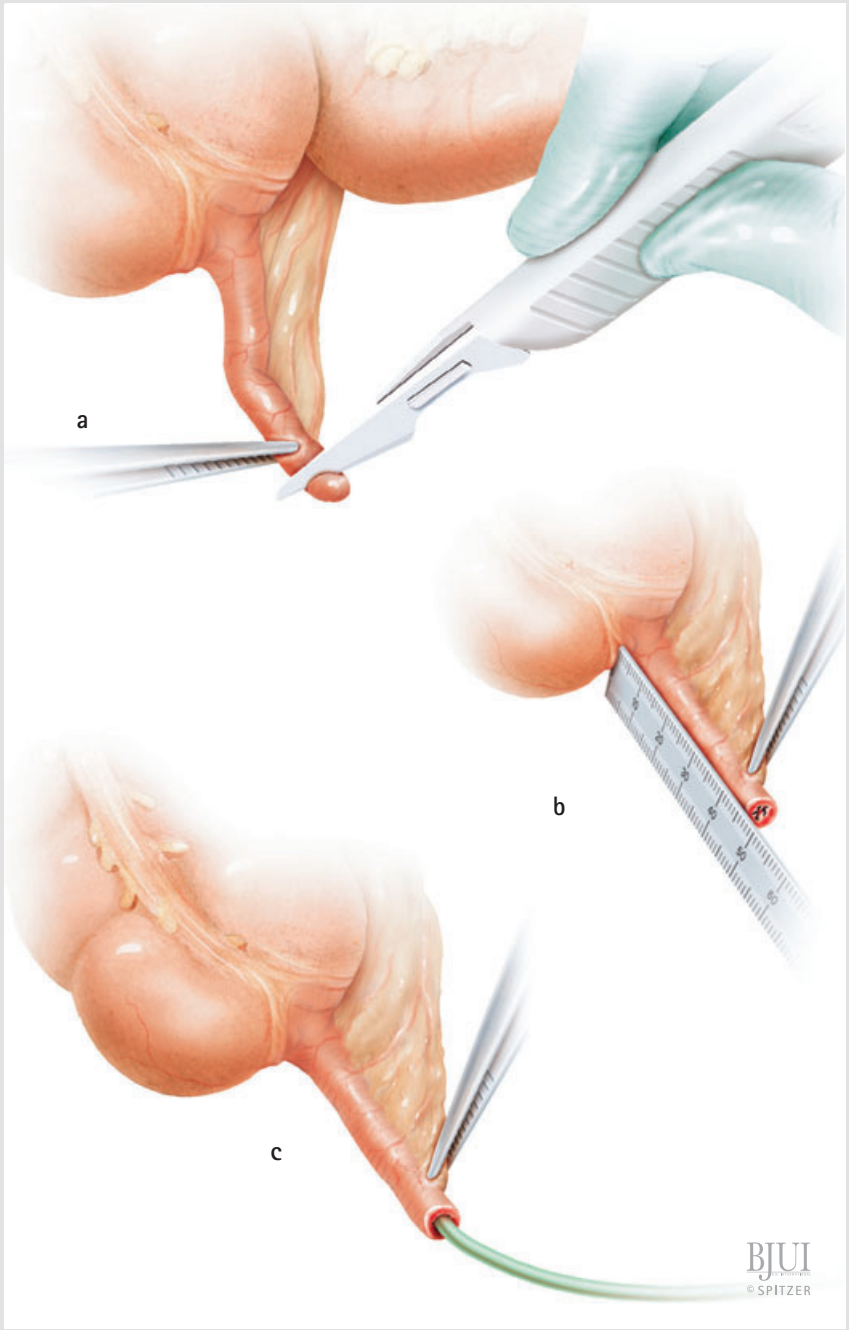

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Figure 5

For this, the open end of the ileum is occluded with a bowel clamp. Arterial line tubing is passed through the open angle of the ascending colon. The butt end of the tubing is connected to a simple standing column manometer. The colon is filled with normal saline using an irrigation (Toomey) syringe through the opening in the ascending colon. The opening is occluded by the fingers and then gentle pressure is gradually applied to the saline-filled colon. Pressure is gradually increased while measuring it by the manometer. The height of the manometer may be adjusted for higher pressures. Appendicular LPP is the pressure at which leakage is noted from the open end of the appendix. If there is no leakage at 70–80 cmH_2O, the appendix is left unaltered.

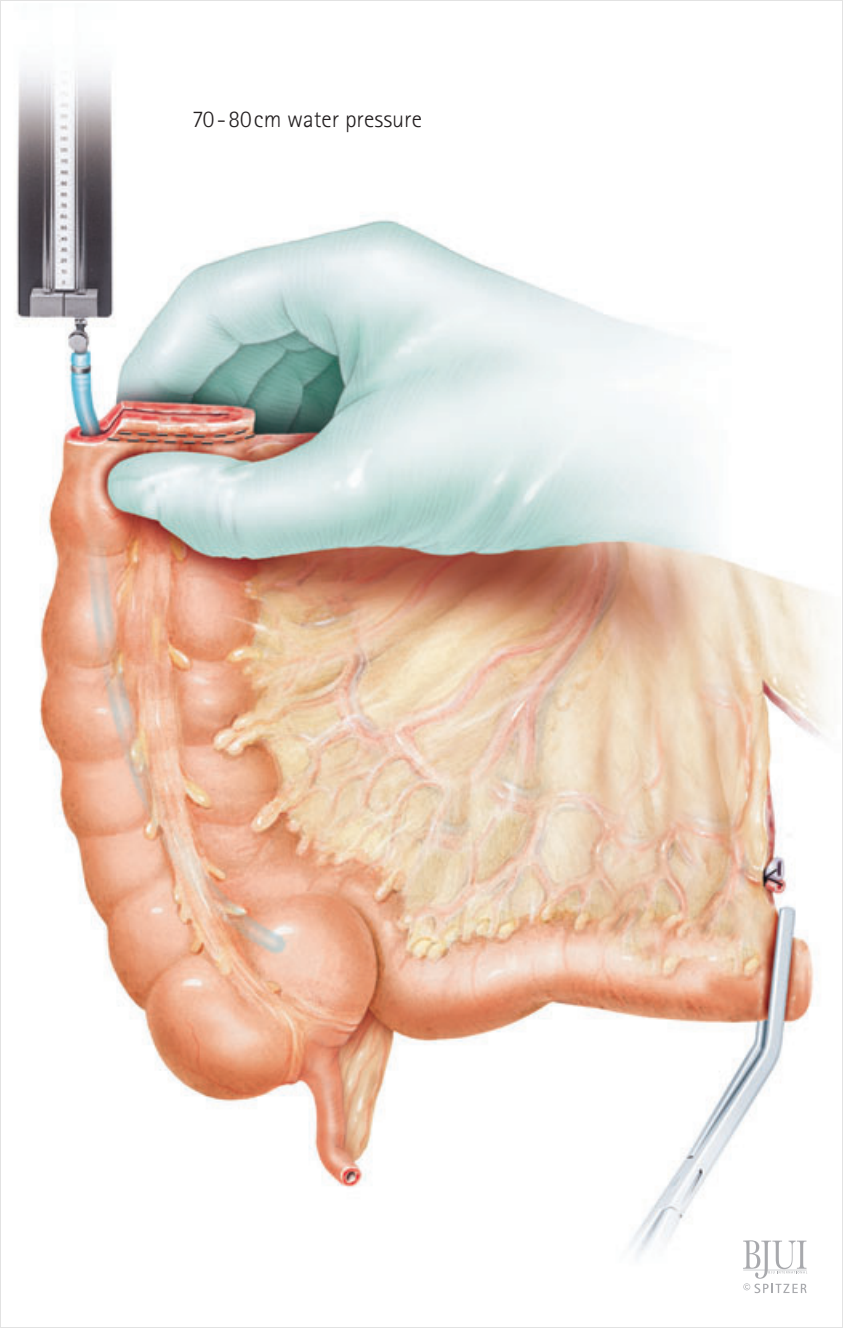

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Figure 6

If leakage occurs at lower pressures, the appendicocolic junction is augmented by using one or occasionally two imbricating (incomplete purse string) seromuscular 2/0 polypropylenesuture(s) in the caecum at the appendicocolic junction. This suture is snugly tied over a 12 F catheter within the appendix (Figure 6b). The appendix LPP is measured again to confirm that it is ≥70cmH_2O. The appendix is catheterized several times to ensure easy unobstructed catheterization.

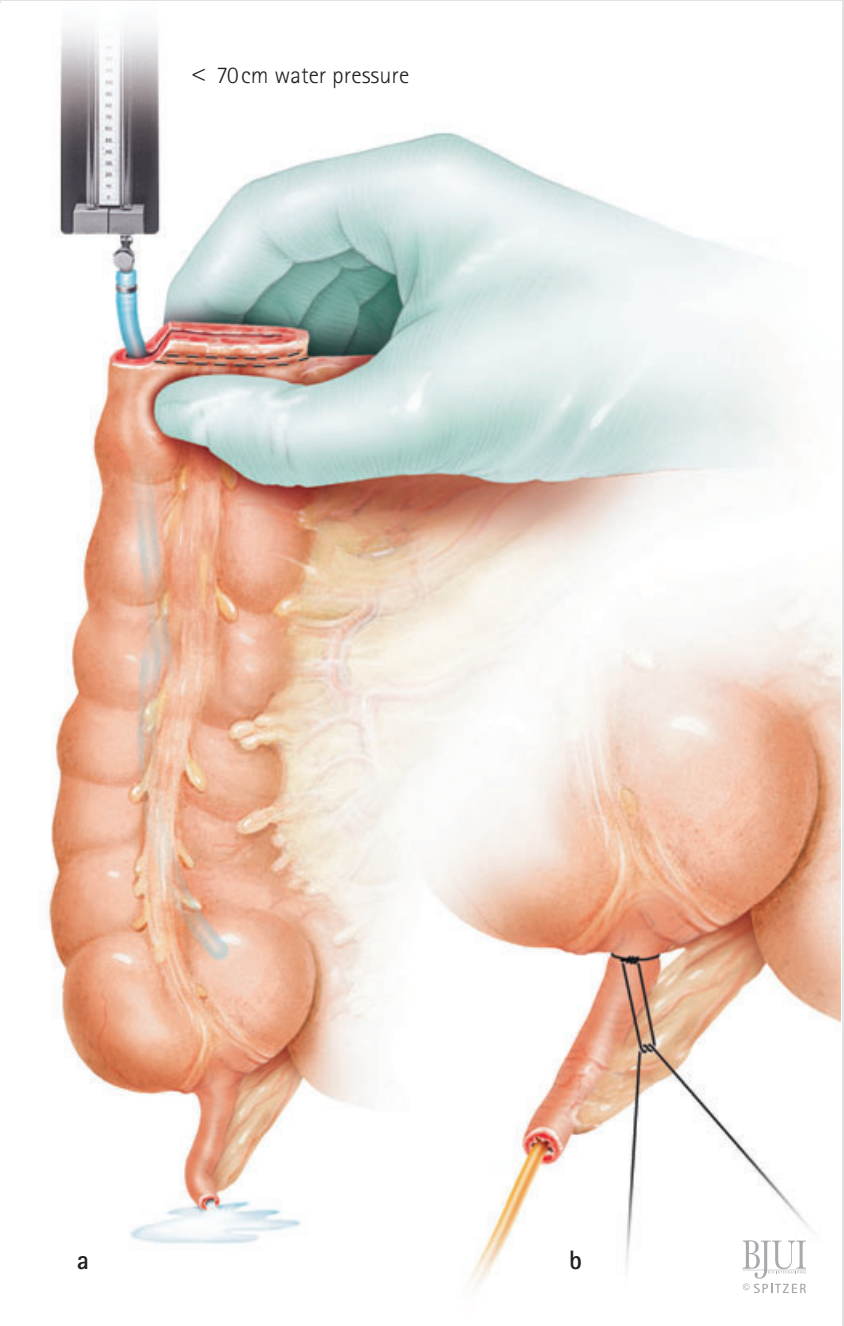

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Figure 7

After ensuring adequate LPP, the reservoir is constructed. The remaining staple line on the colon is excised. The ileum, caecum and colon are opened completely along the antimesenteric border. We use electrocautery over a free plastic tip of a suction device to expedite this process.

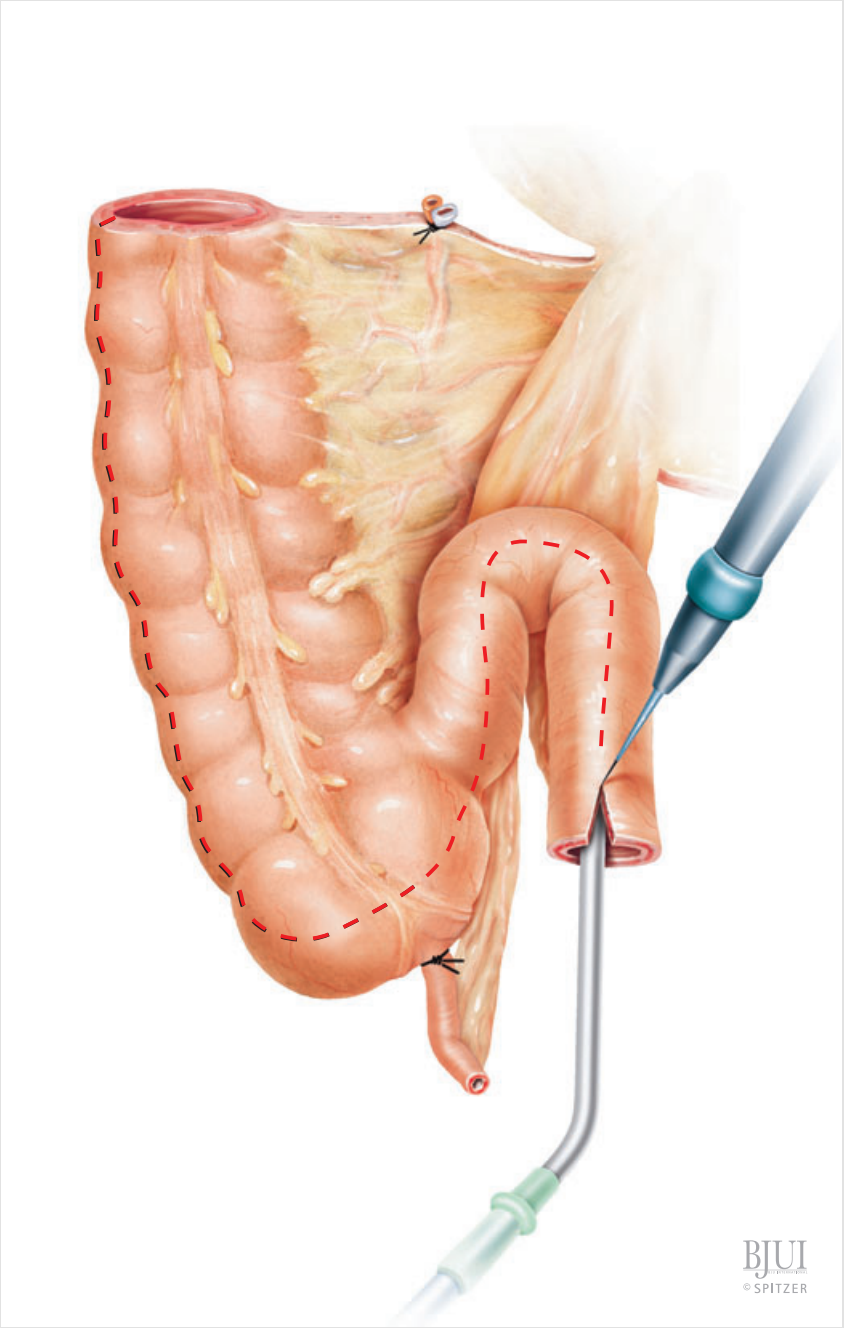

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Figure 8

The colon and the ileum are then each formed into a 'U-shaped' patch using 3/0 continuous polyglactin sutures and the two patches are approximated to each other. A straight Keith needle can shorten the time required for the suturing. The ureters have usually been mobilized earlier during preliminary procedures. It is emphasized that for this procedure, only adequate length to ensure tension-free anastomosis is required. Maintaining adequate periureteric tissue and adventitia is necessary to minimize the risk of ischaemic stricture. Ureterointestinal anastomosis is made at the surgeon's preference. There is some controversy about the necessity and wisdom of providing an anti-refluxing ureterointestinal anastomosis. Our preference is to construct a short serous-lined tunnel in the ileum and colon respectively.

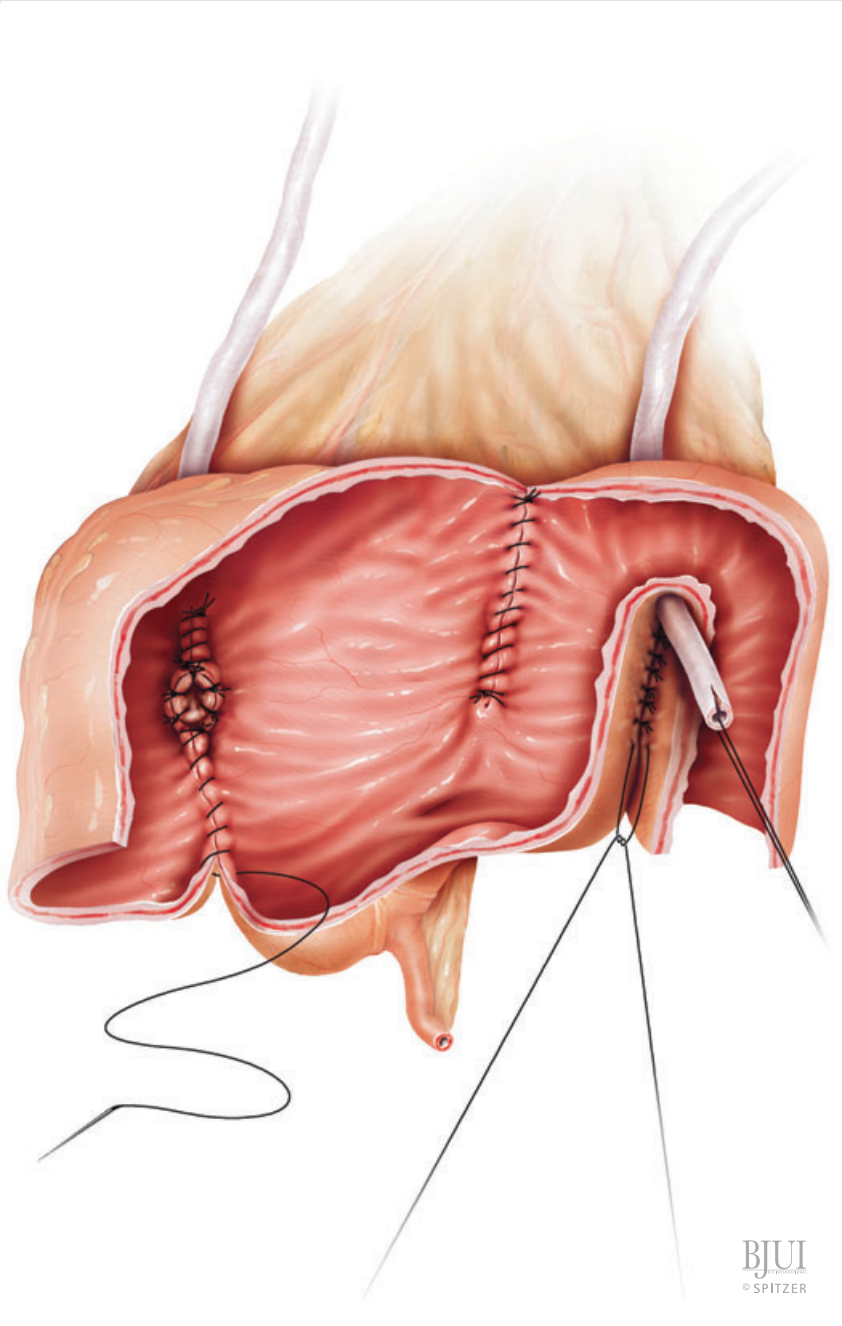

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Figure 9

Each ureter is stented with a single-J or similar stent and the stent is secured to the mucosa with 4/0 chromic sutures.

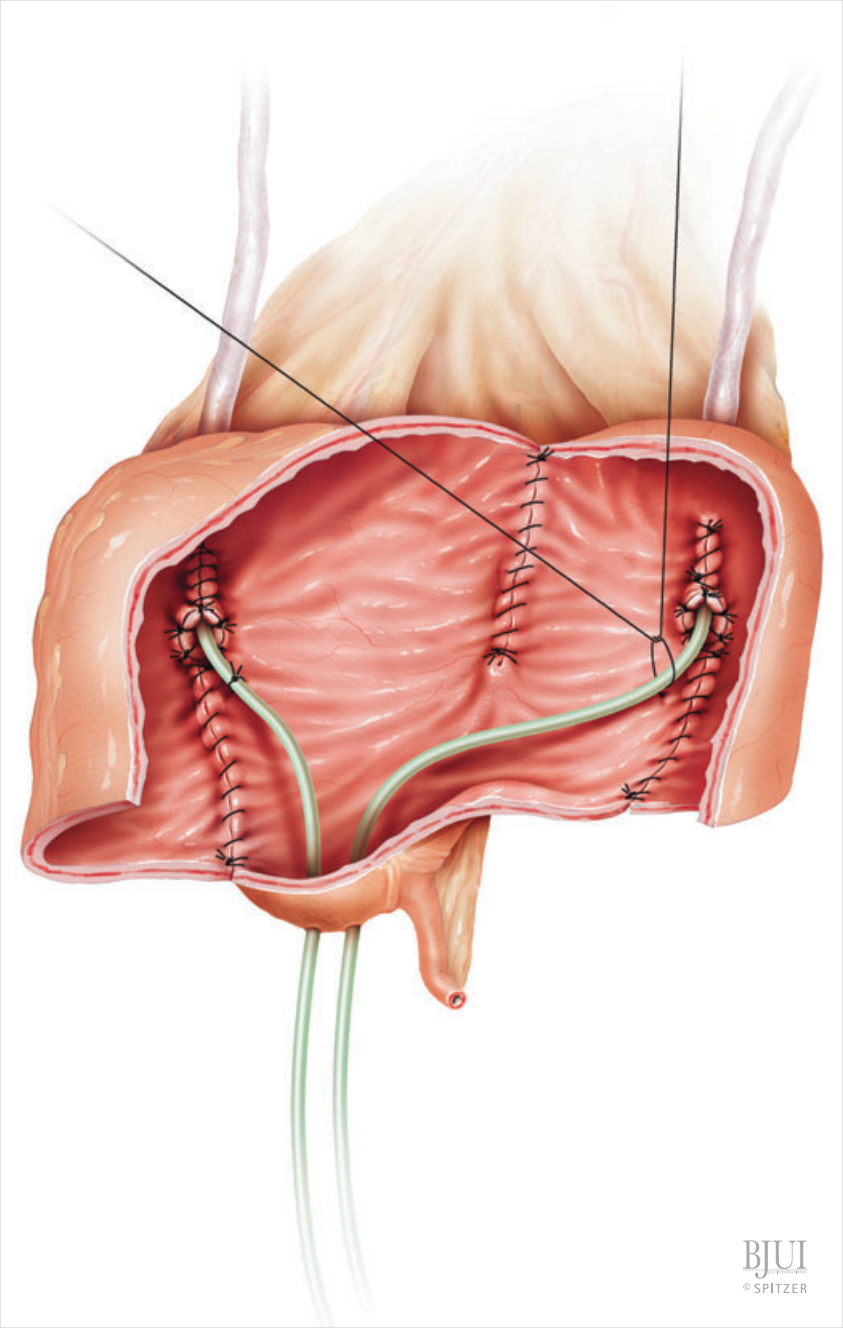

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Figure 10

A 24 F Malecot catheter is left in the reservoir as a caecostomy tube for adequate pouch drainage. It is brought out through a separate stab incision. The colonic and ileal patches are approximated anteriorly to close the reservoir. The pouch is filled with saline and any obvious leaking areas are closed.

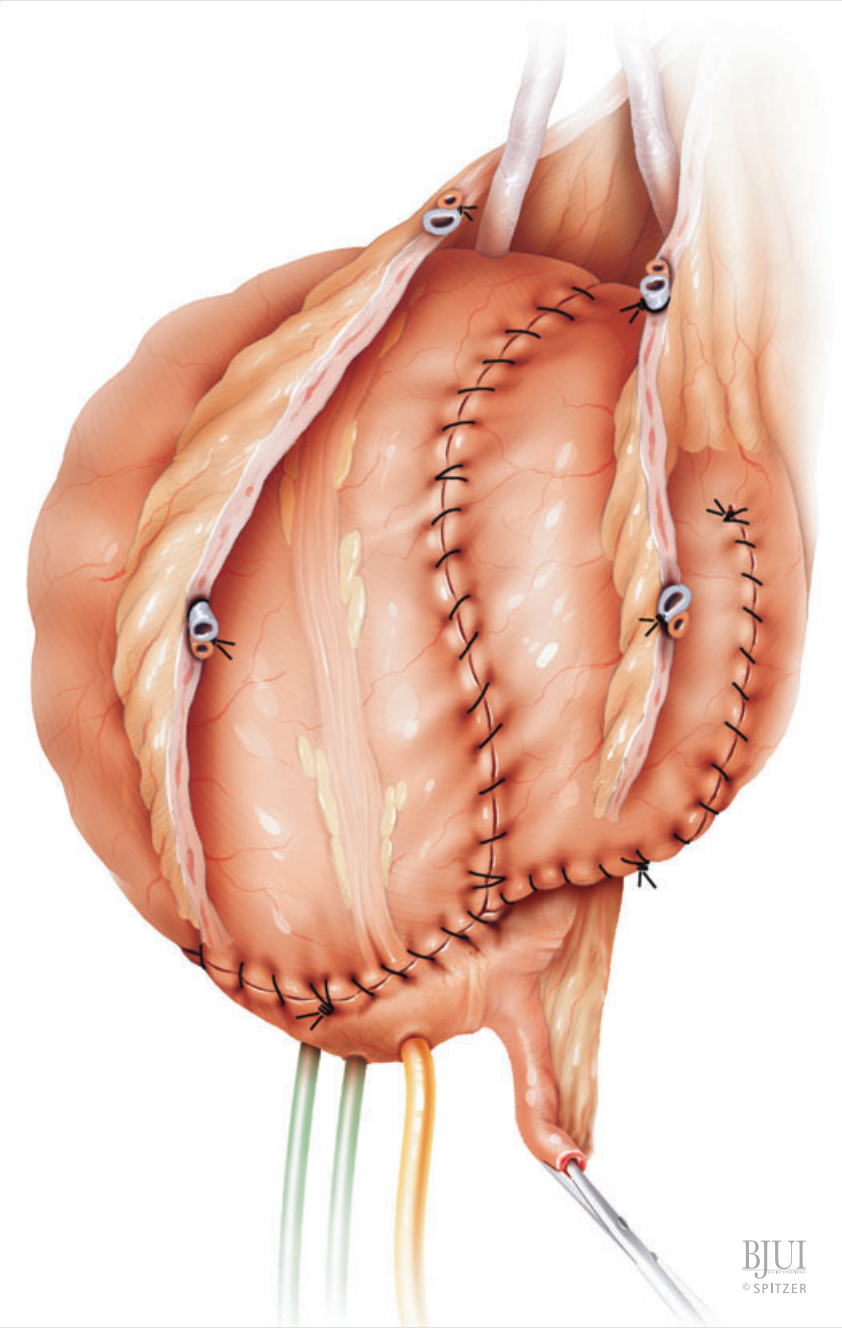

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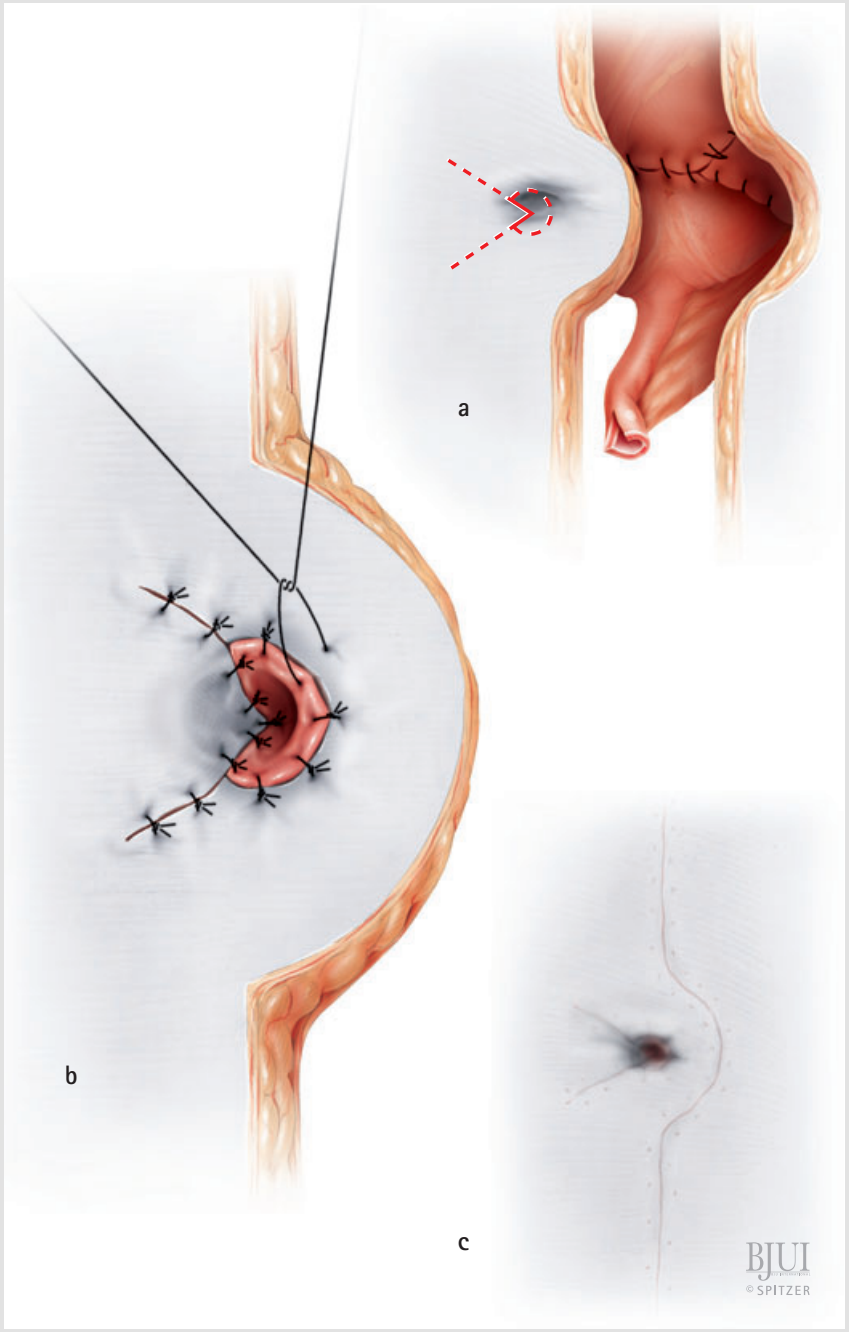
Figure 11

Stoma construction: The stoma is created at the umbilicus [6]. A 2.5-cm triangular skin flap is raised to the right of the umbilicus with the apex medial and the base lateral. A 1-cm core of the umbilical scar medial to the triangular skin flap is excised down to the peritoneum (a). The appendix is then passed through this defect. The appendix is spatulated at its antimesenteric border for slightly over 1 cm and oriented so that the spatulation is on the right side opposite the skin flap. The triangular skin flap is sutured to the spatulated appendix with 2/0 polyglactin interrupted sutures. The remaining edges are anastomosed to the surrounding skin (b). This simple technique creates a concealed umbilical stoma (c) [4,6,7].

The pouch is filled through the Malecot catheter and is catheterized through the appendix a few times to ensure easy catheterization. A 10 or 12 F rubber catheter is then placed in the pouch through the appendix and is secured with two or three separate silk sutures to ensure it remains indwelling until the patient returns for follow-up and the initiation of intermittent catheterization. Favourable experience with this technique was reported by prominent authors [7].



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POSTOPERATIVE CARE AND FOLLOW-UP

Routine postoperative care is provided. Nasogastric decompression is provided for a few days until bowel function returns. Ureteric stents are maintained for 8–10 days with removal over 2 consecutive days. The drain is left on bulb suction for 1–2 days and then changed to straight drainage. The drain is removed 1 day after stent removal. Patients are seen on an outpatient basis at 6 weeks postoperatively, at which time a pouchogram and an upper tract study are done. The tubes are removed and patient and/or family are instructed and trained on proper stoma catheterization technique and general care of the pouch, including irrigation and trouble shooting. Patients are followed up after 3 months and then every 6 months. Investigations conducted include urine analysis and cultures, routine chemistries as well as measuring vitamin B12 levels. Upper tract imaging is done yearly. A modest dose of vitamin B12 is given twice yearly [8].

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Abbreviation: **LPP**, leak-point pressure.

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